

NUMBERS AND SUCCESS

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It is easy to remove passages from a general discussion and attribute to them a meaning they were not intended to have. Also, in a long discussion, statements may be made so far from expressions of the central concept that their significance is overlooked.

Presumably in one of these ways Dr. McAtee (1949) in this journal has misapplied some remarks of mine (Shull, 1936) concerning the road to success in evolution. After quoting part of an account of the way in which natural selection was at first supposed to work through life-and-death distinctions, he portrays my substitute for that method as dependent on the thesis that "success or failure depends on numbers," and that "numbers . . . constitute the best assurance of permanence." He then proceeds to apply this concept to species. His reader no doubt compares the number of grizzly bears with the number of flies that annoy them, and concludes that if the numbers of individuals were equal the bears could be fairly happy—irrespective of their chances of survival as compared with the insects. Man with his two billion or so should be in no danger—unless, as some people fear, from himself; but a bacterial species made up of only two billion individuals might well be on the verge of extinction. No one could seriously maintain that numbers of individuals, without reference to the kind of organism, would be a good measure of success or a good insurance policy.

To understand the wrong application here, one must remember that the book quoted was the first *general* work on evolution to emphasize the genetic factors. The early chapters dealt with the traditional arguments about evidences of evolution; but long before page 152, from which McAtee quotes, the genetic groundwork was laid and the evolutionary operation of the genetic mechanism was described. A species was best described as possessing various alternative genes in certain frequencies—68 per cent of A , 19 per cent of a , and 13 per cent of a' , and so on for all the loci of genes in the chromosomes. The frequency of one of these genes would change from generation to generation, and such changes would be evolution. Even if they never led to a change of phenotype which a taxonomist would dignify by calling a new species, the change of frequency of alternative genes was really evolution. Much evolution has been lost, but it was evolution. The bulk of evolution has been effected by such changes of frequency of genes.

When gene A first mutates to a , the latter gene is rare. Accordingly, it may be lost. But to be lost, the individual that contains it must be lost or its germ cells fail to contribute to new individuals. If gene a is to increase in frequency, the individuals that contain it must leave relatively more descendants than do those containing only A . Whether more descendants are to be had by good luck, or only by possessing some advantage associated with gene a , is immaterial; increase of the frequency of the new gene requires increase of the individuals carrying it. Such increase of individuals could be arrived at by further mutations of A to a . If A mutates to a often enough, and there is no opposing factor, gene a gradually replaces A . The whole species could eventually be made to possess gene a , to the exclusion of A , merely by repeated mutations to a . All this would involve, of course, getting more and more individuals carrying the new gene.

The import of "numbers of individuals" should now be clear. Numbers of elephants are not being contrasted with numbers of mice. No species is contrasted with another species. It is numbers of individuals carrying gene a instead of A , or carrying gene m instead of M or m' , that matters. If gene b is to succeed in evolution, at the expense of b' or B , that success can be attained only by increasing the number of individuals possessing b . An effective way of getting an increase of such individuals, after the new gene comes to expression, is for it to possess an advantage over the old gene. This advantage must be one that leads its possessor to produce more descendants. A new gene that makes the life of its possessor more comfortable, but does not increase its descendants, is not advantageous in the evolutionary sense. Such a gene, if it succeeded in becoming permanent, would owe that success to some other factor than selection; but whatever that factor were, it would have to operate by increasing the number of individuals possessing the new gene.

The paragraphs containing the passages quoted by McAtee contain nothing to indicate that it is success of species in relation to other species that is insured by numbers of individuals. Not even the page, nor the chapter, nor the whole book gives any expression to that idea. Everywhere it is characters, more directly the genes, whose permanence is made more probable by numbers of individuals. Though the words "class" and "type" are used, in no part of the discussion do they have a taxonomic meaning. The "class" of individuals possessing a certain gene is contrasted with another "class" or "type" having one of the alternative genes at the same locus. The reader should have no difficulty in seeing that the words have that meaning. If one of these "classes" has more descendants, its genetic basis becomes more prevalent—is more successful. It would be unfortunate to have the genetic argument used in support of mere numbers as a measure of success of species, particularly of unrelated or only distantly related species.

LITERATURE CITED

- McAtee, W. L. 1949. Numerical abundance as the criterion for successful species. *Ohio Jour. Science* 49: 169-172.
 Shull, A. F. 1936. *Evolution*. x+312 pp. New York. McGraw-Hill Book Co., Inc.

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